

CLAIMS

1. A method of manufacturing a steel product, comprising the step of heat treating a steel product having been subjected to quenching or accelerated cooling on a hot rolling line after hot rolling by passing the steel product through a plurality of induction heating apparatuses, which are installed on the hot rolling line, three times or more.

2. The method of manufacturing a steel product according to claim 1, wherein a transfer speed of the steel product is changed every time of passage through the induction heating apparatuses.

3. The method of manufacturing a steel product according to claim 1, wherein in the case where heat treatment is carried out with the number of times of passage being n equal to or more than three, transfer speeds of the steel product at n th passage and at $(n-1)$ th passage are larger than those at $(n-2)$ th passage or before.

4. A method of manufacturing a steel product, comprising the step of heat treating a steel product having been subjected to quenching or accelerated cooling on a hot rolling line after hot rolling by passing the steel product through a plurality of induction heating apparatuses, which are installed on the

hot rolling line, at least once, and

wherein the number of times of passage through the induction heating apparatuses is such a number of times that surface temperature and thickness-wise center temperature of the steel product fall in a predetermined temperature range in the shortest time.

5. The method of manufacturing a steel product according to claim 4, wherein the number of times of passage through the induction heating apparatuses is such a number of times that heat treatment time determined from the relationship between the number of times of passage, the transfer speed of steel product, and the electric power for the induction heating apparatuses, which is found using the dimensions and the necessary temperature rise of the steel product, is the shortest.

6. The method of manufacturing a steel product according to claim 4, wherein in the case where heat treatment is carried out with the number of times of passage being three or more, a transfer speed of the steel product is changed every time of passage through the induction heating apparatuses.

7. The method of manufacturing a steel product according to claim 4, wherein in the case where heat treatment is carried out with the number of times of passage being n equal to or

more than three, transfer speeds of the steel product at n th passage and at $(n-1)$ th passage are larger than those at $(n-2)$ th passage or before.

8. A method of manufacturing a steel product, comprising the step of heat treating a steel product having been subjected to quenching or accelerated cooling on a hot rolling line after hot rolling by passing the steel product through a plurality of induction heating apparatuses, which are installed on the hot rolling line, at least once, and

wherein the number of times of passage through the induction heating apparatus is such a number of times that surface temperature and thickness-wise center temperature of the steel product fall in a predetermined temperature range within a target treatment time.

9. The method of manufacturing a steel product according to claim 8, wherein a target treatment time is set to the time, which prevents a succeeding steel product from waiting in processes prior to heat treatment process, or the time making a waiting time of the succeeding steel product shortest when passed the target treatment time.

10. The method of manufacturing a steel product according to claim 9, wherein a target treatment time is calculated on the

basis of the time, at which cooling of a succeeding steel product is completed, or the basis of time, at which the succeeding steel product arrives at the induction heating apparatuses.

11. The method of manufacturing a steel product according to claim 9, wherein the number of times of passage through the induction heating apparatuses is a number making electric power consumption minimum, among such numbers of times that heat treatment time determined from the relationship between the number of times of passage, the transfer speed of the steel product, and the electric power for the induction heating apparatuses, which relationship is found using the dimensions and the necessary temperature rise of the steel product, falls within a target treatment time.

12. A method of manufacturing a steel product, comprising the step of heat treating a steel product having been subjected to quenching or accelerated cooling on a hot rolling line after hot rolling by passing the steel product through a plurality of induction heating apparatuses, which are installed on the hot rolling line, at least once, and

wherein the steel product is subjected to heat treatment so that heat treatment time, which is calculated on the basis of the dimensions and the necessary temperature rise of the steel product, the number of times of passage through the

induction heating apparatuses, and heating capacities of the induction heating apparatuses, and which elapses until surface temperature of the steel product does not exceed a predetermined upper limit temperature and temperature in a predetermined position inside the steel product reaches a target temperature, falls within a target treatment time.

13. The method of manufacturing a steel product according to claim 12, wherein a target treatment time is set to the time, which prevents a succeeding steel product from waiting in processes prior to heat treatment process, or the time making a waiting time of the succeeding steel product shortest when passed the target treatment time.

14. The method of manufacturing a steel product according to claim 13, wherein heating of a steel product is completed within a target treatment time and performed so that power consumption is made minimum.

15. The method of manufacturing a steel product according to claim 13, wherein in the case where heat treatment is carried out with the number of times of passage being three or more, a transfer speed of the steel product at the last time of passage is larger than that at the first time of passage.

16. A method of manufacturing a steel product, comprising the step of heat treating a steel product having been subjected to quenching or accelerated cooling on a hot rolling line after hot rolling by passing the steel product through a plurality of induction heating apparatuses, which are installed on the hot rolling line, at least once, and

wherein the steel product is subjected to heat treatment so that heat treatment time, which is calculated on the basis of the dimensions and the necessary temperature rise of the steel product, the number of times of passage through the induction heating apparatus, and heating capacities of the induction heating apparatus, and which elapses until surface temperature of the steel product does not exceed a predetermined upper limit temperature and temperature in a predetermined position inside the steel product reaches a target temperature, becomes the shortest.

17. The method of manufacturing a steel product according to claim 16, wherein in the case where heat treatment is carried out with the number of times of passage being three or more, a transfer speed of the steel product at the last time of passage is larger than that at the first time of passage.

18. A method of manufacturing a steel product, comprising the step of heat treating a steel product having been subjected

to quenching or accelerated cooling on a hot rolling line after hot rolling by passing the steel product through two to five induction heating apparatuses, which are installed on the hot rolling line, three times or more.

19. The method of manufacturing a steel product according to claim 18, wherein heat treatment is carried out with the number of times of passage, which prevents a succeeding steel product from waiting in processes prior to heat treatment process, or which makes a waiting time of the succeeding steel product shortest in the case where the succeeding steel material waits in the preceding process.

20. The method of manufacturing a steel product according to claim 19, wherein in the case where heat treatment is carried out with the number of times of passage being three or more, a transfer speed of the steel product at the last time of passage is larger than that at the first time of passage.

21. Manufacturing facilities of steel product comprising, on a hot rolling line;

a hot rolling mill,

a quenching or accelerated cooling apparatus,

a plurality of induction heating apparatuses, and

an operating unit for heat treatment pattern of the

induction heating apparatuses, and

wherein the operating unit comprises;

means to calculate scheduled time, at which a steel product having been subjected to quenching or accelerated cooling after hot rolling reaches the induction heating apparatuses, and

means to determine a heat treatment pattern, which prevents a succeeding steel product to be subjected to heat treatment from waiting on the hot rolling line, from the dimensions and the necessary temperature rise of the steel product, and scheduled time, at which the succeeding steel product reaches the induction heating apparatuses.